

# **Documentation of the AMS-02 TRD Mock-Up MLI Tailoring & Cabling**

Philip von Doetinchem

November 10, 2005

## Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>Definition of volume for MLI tailoring</b>	<b>4</b>
2.1	Survey of the walls . . . . .	5
2.2	Constraints for MLI tailoring . . . . .	9
2.2.1	MLI fixations . . . . .	9
2.2.2	Details of inner volume for the MLI . . . . .	10
<b>3</b>	<b>Cabling</b>	<b>14</b>
3.1	Cabling on rosengetter . . . . .	14
3.2	UToF & ACC cabling . . . . .	16
3.3	Cable supports . . . . .	17
3.4	LFCR box with cabling . . . . .	20
3.5	Labeling scheme for the cables . . . . .	21
3.6	Routing . . . . .	23
3.7	U- & UG-crate assignment . . . . .	26
3.8	Lengths . . . . .	26
<b>4</b>	<b>Gas tubing of manifolds</b>	<b>30</b>

## List of Figures

1	Principle of MLI wrapping . . . . .	4
2	AMS-02 TRD Mock-up overview . . . . .	5
3	Wall 1 (PORT) . . . . .	5
4	Wall 2 . . . . .	6
5	Wall 3 (WAKE) . . . . .	6
6	Wall 4 . . . . .	7
7	Wall 5 (STARBOARD) . . . . .	7
8	Wall 6 . . . . .	8
9	Wall 7 (RAM) . . . . .	8
10	Wall 8 (RAM) . . . . .	9
11	MLI fixations on WAKE and RAM . . . . .	9
12	MLI fixations on STARBOARD and PORT . . . . .	10
13	ISATEC drawing of M-structure . . . . .	10
14	Dimensions of cable supports for cable feedthroughs wall 3 (WAKE) . . . . .	11
15	Dimensions of cable supports for cable feedthroughs wall 7 (RAM) . . . . .	11
16	Star tracker baffle & corner bracket . . . . .	12
17	Upper brackets and brackets for zenith radiator . . . . .	12
18	Upper brackets with spokes for zenith radiator . . . . .	13
19	Upper cover with spokes for zenith radiator . . . . .	13
20	Cabling on rosengetter at wall 3 (WAKE) . . . . .	14
21	Cabling on rosengetter at wall 7 (RAM) . . . . .	14
22	Temperature cables at bridges . . . . .	15
23	Patch panel for temperature cables . . . . .	15
24	Overview uToF system . . . . .	16
25	uToF cabling at wall 4 . . . . .	16
26	SHV box at wall 3 (WAKE) . . . . .	17
27	Cabling on UG-crate at wall 3 (WAKE) . . . . .	17
28	Cable supports crates at wall 3 (WAKE) . . . . .	18

*List of Tables*

---

29	Cable supports crates at wall 7 (RAM) . . . . .	18
30	Cabling crates at wall 7 (RAM) . . . . .	19
31	Cable supports M-structure at wall 3 (WAKE) . . . . .	19
32	Cable supports M-structure at wall 7 (RAM) . . . . .	20
33	LFCR box cabling at wall 7 (RAM) . . . . .	20
34	ISATEC drawing of LFCR box ground plate . . . . .	21
35	Labeling of TRD signal and HV cables . . . . .	22
36	Coordinate system of the rosgitter . . . . .	23
37	Distribution of TRD HV and signal cable lengths . . . . .	26
38	Gas tubing at the octagon . . . . .	30
39	Manifolds at wall 3 (WAKE) . . . . .	30
40	Interferences: manifolds with UFE/gas chain . . . . .	31

**List of Tables**

1	Routing for TRD signal and HV cables in layer 1 . . . . .	23
2	Routing for TRD signal and HV cables in layer 2 . . . . .	24
3	Routing for TRD signal and HV cables in layer 3 . . . . .	24
4	Routing for TRD signal and HV cables in layer 4 . . . . .	24
5	Routing for TRD signal and HV cables in layer 5 . . . . .	25
6	Routing for manifold control cables . . . . .	25
7	Routing for temperature cables from temp. patch panel to UG-crate . . . . .	25
8	Routing for cables from temp. patch panel to bridges (wall 1 & 3) . . . . .	25
9	Routing for cables from temp. patch panel to bridges (wall 5 & 7) . . . . .	25
10	Assignment of slots in U-crates. Looking out from center . . . . .	26
11	Assignment of slots in UG-crate for UGSCMs. Looking out from center . . . . .	26
12	Lengths for TRD HV and signal spare cables . . . . .	27
13	Lengths for TRD signal and HV cables in layer 1 . . . . .	27
14	Lengths for TRD signal and HV cables in layer 2 . . . . .	27
15	Lengths for TRD signal and HV cables in layer 3 . . . . .	27
16	Lengths for TRD signal and HV cables in layer 4 . . . . .	28
17	Lengths for TRD signal and HV cables in layer 5 . . . . .	28
18	Lengths for manifold control cables . . . . .	29
19	Lengths for temperature cables from temp. patch panel to UG-crate . . . . .	29
20	Lengths for LFCR signal cables . . . . .	29
21	Lengths for cables from temp. patch panel to bridges (wall 1 & 3) . . . . .	29
22	Lengths for cables from temp. patch panel to bridges (wall 5 & 7) . . . . .	29

## 1 Introduction

The AMS-02 TRD mock-up is needed for different purposes:

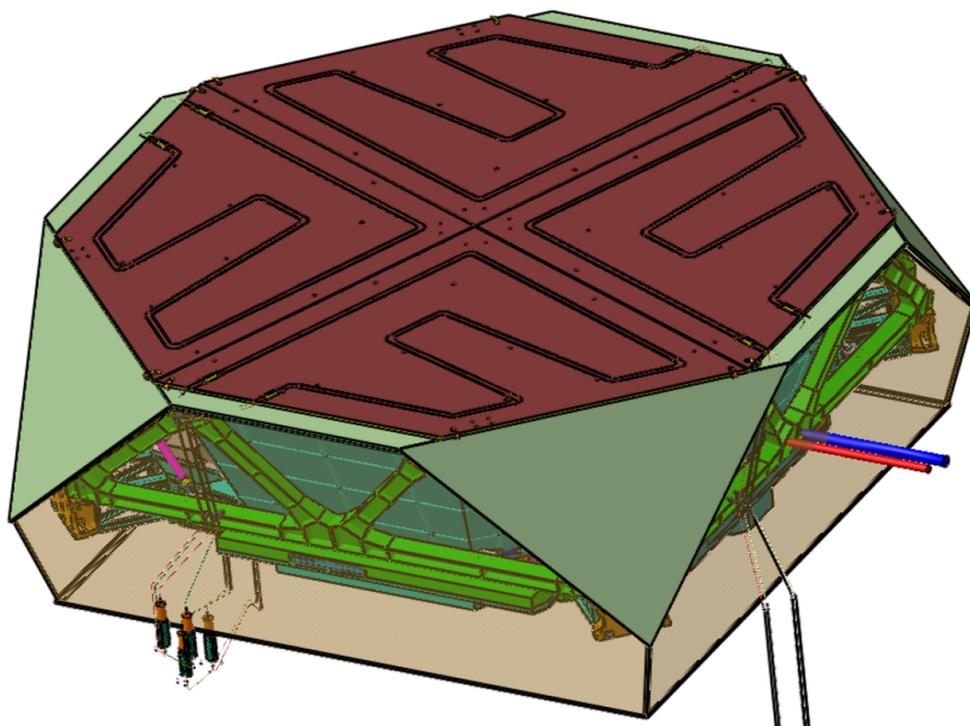
- ✧ explore interferences between the different mechanical and electrical parts,
- ✧ define the inner volume for the MLI wrapping,
- ✧ do cabling of all cables concerning TRD<sup>1</sup> and uToF<sup>2</sup> and determine the cable lengths,
- ✧ design of cable supports at crates and M-structure.

## 2 Definition of volume for MLI tailoring

Fig. 1 shows the principle of MLI<sup>3</sup> to be wrapped around TRD and uToF. Purposes of the MLI are:

- ✧ electrical shielding,
- ✧ isothermal insulation.

Fig. 2 shows an overview of the mock-up in the side view.



**Figure 1:** Principle of MLI wrapping

---

<sup>1</sup>Transition Radiation Detector

<sup>2</sup>upper Time of Flight

<sup>3</sup>MultiLayer Insulation

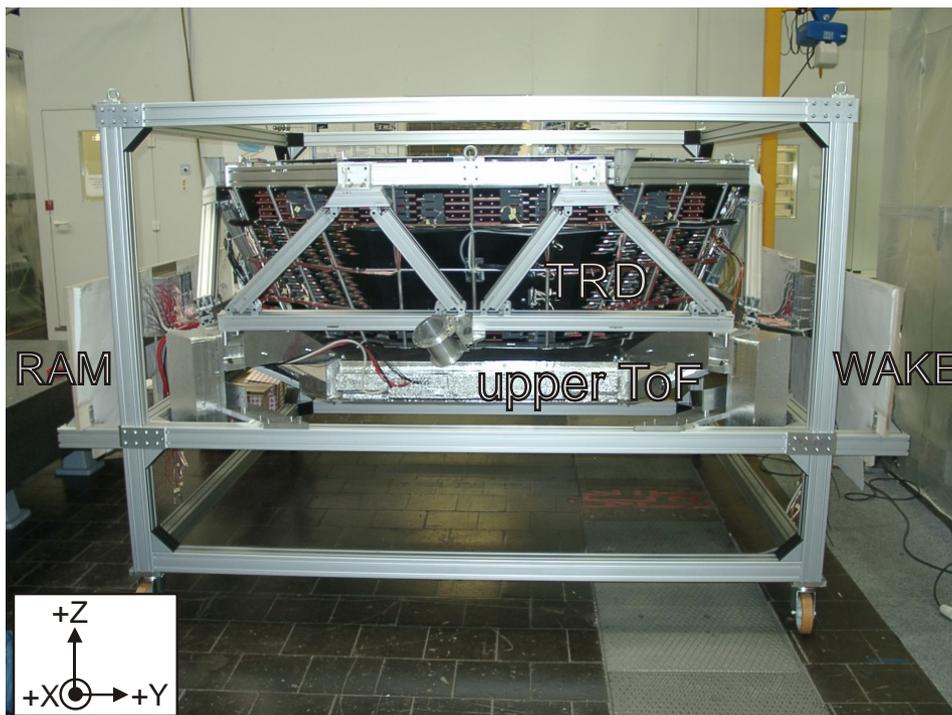


Figure 2: AMS-02 TRD Mock-up overview

## 2.1 Survey of the walls

This section (fig. 3 - 10) gives an overview over the several walls with the cabling and possible difficulties for the MLI tailoring. Fig. 3 shows wall 1 with a star tracker baffle. For a detailed picture of the baffle see fig. 16. Fig. 4 shows a picture with gas tubes running from the rosengetter to the M-structure. For more information on the gas tubes to the manifolds see sec. 4.



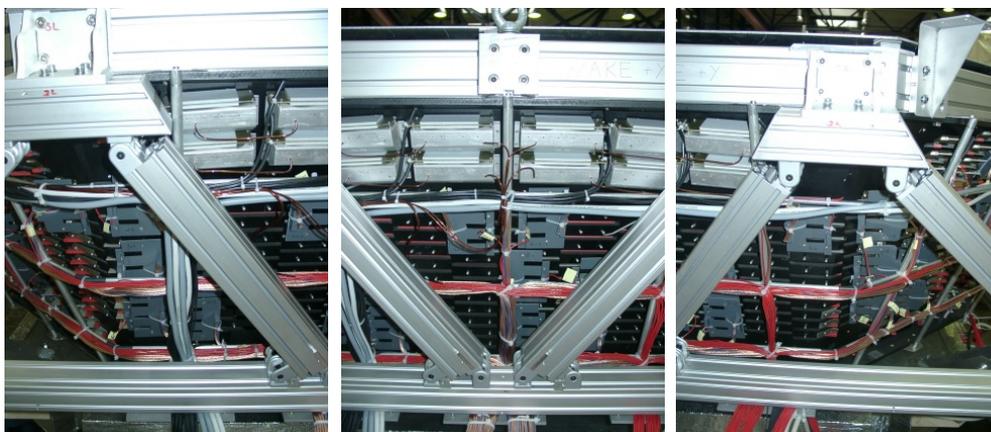
Wall 1 - Port

Figure 3: Wall 1 (PORT)



Wall 2

Figure 4: Wall 2



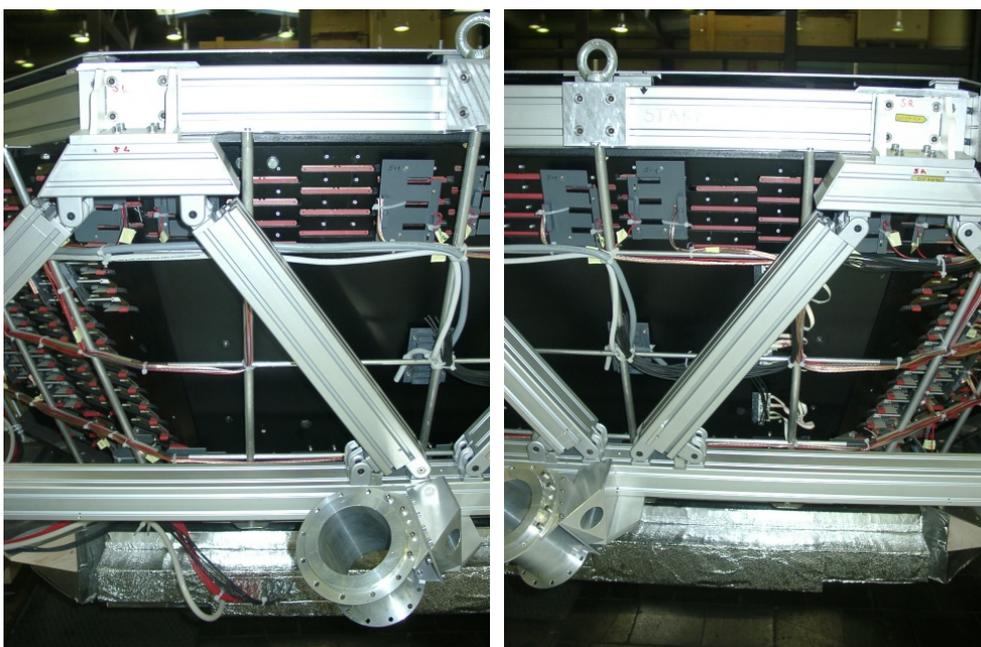
Wall 3 - Wake

Figure 5: Wall 3 (WAKE)



Wall 4

Figure 6: Wall 4



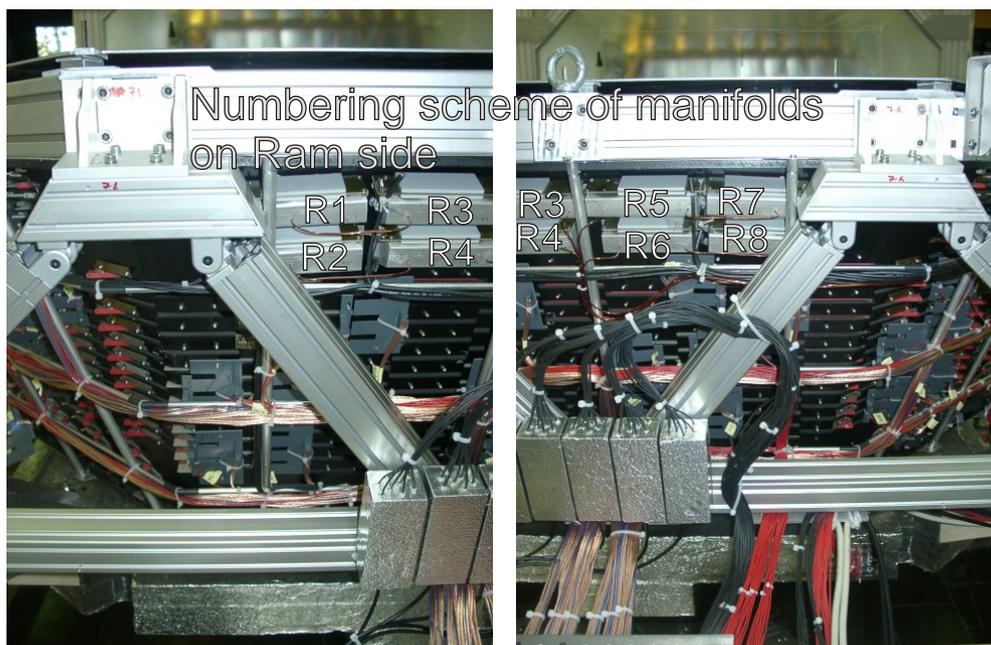
Wall 5 - Starboard

Figure 7: Wall 5 (STARBOARD)



Wall 6

Figure 8: Wall 6



Wall 7 - Ram

Figure 9: Wall 7 (RAM)



Wall 8

Figure 10: Wall 8 (RAM)

## 2.2 Constraints for MLI tailoring

### 2.2.1 MLI fixations

Fig. 11 and 12 shows the foreseen MLI fixation points that are available on each side. The RAM side has the difficulty of the LFCR box and PORT and STARBOARD have one fixation point less because of the star tracker baffles. Fig. 13 is a drawing of the M-structure with all fixation points M and L. On the RAM side the L points are used for the LFCR box, but on the other sides they can also be used for MLI fixation.



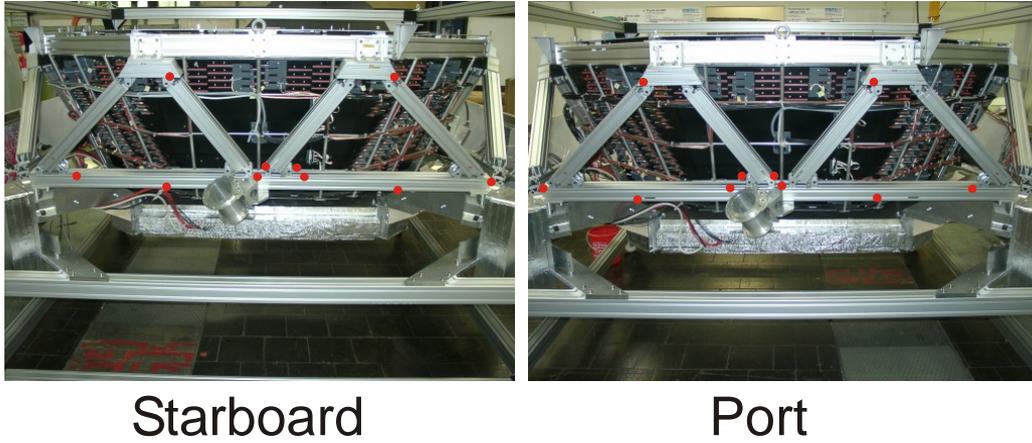
Wake +Y



MLI fixations (●)

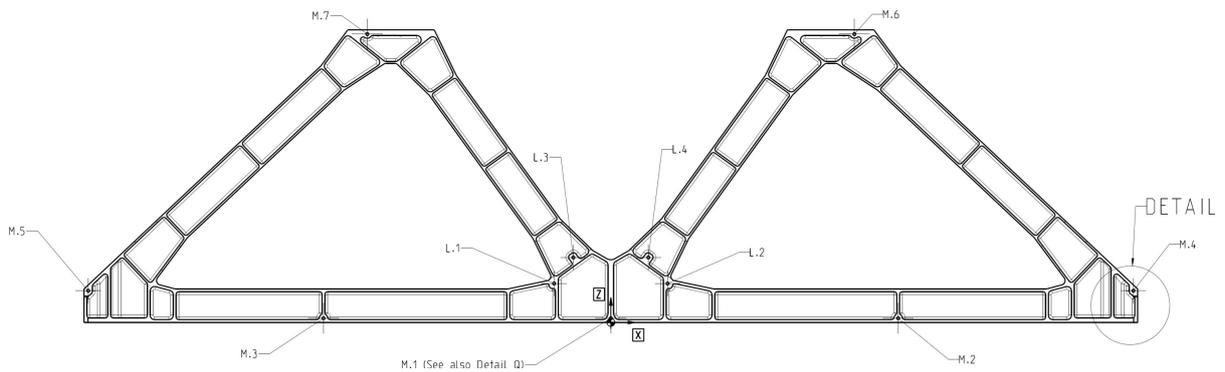
Ram -Y

Figure 11: MLI fixations on WAKE and RAM



### MLI fixations (●)

**Figure 12:** MLI fixations on STARBOARD and PORT



**Figure 13:** ISAtec drawing of M-structure

#### 2.2.2 Details of inner volume for the MLI

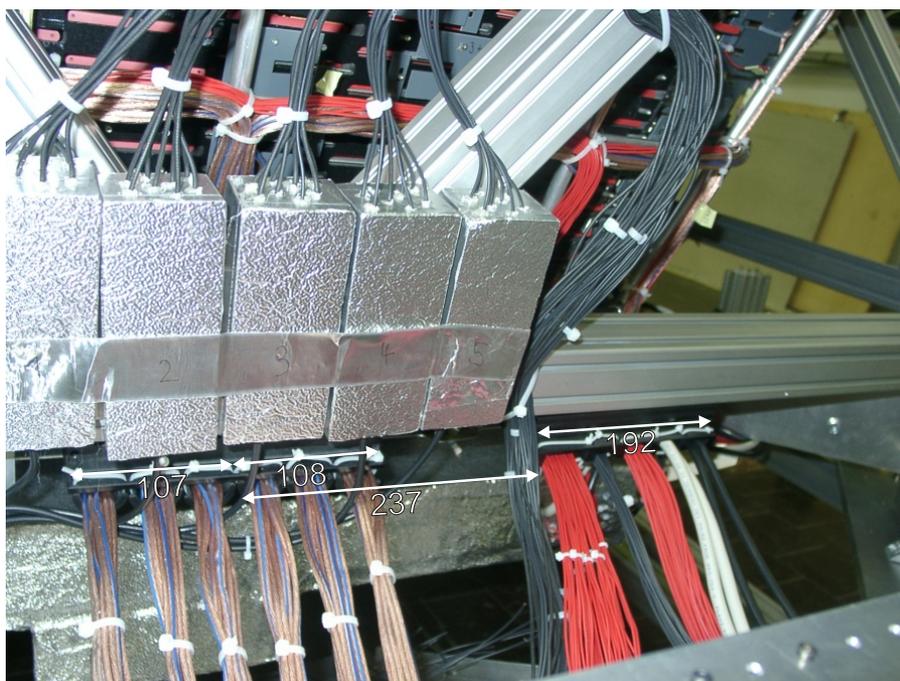
The MLI needs several cable feedtroughs for the different cable types. Fig. 14 and 15 show the dimensions of the supports and their position on the M-Structure. Star tracker baffles are mounted in the middle of the M-structure of wall 1 and 5 (fig. 16, left). Between the M-structures are corner brackets which are connected to the USS (fig. 16, right). Fig. 17 and 18 shows different types of upper brackets. The right one on each wall has a bracket and the left one has a spoke for the zenith radiator. The upper MLI sheet needs holes for each zenith radiator spoke (fig. 19). Further difficulties for MLI tailoring are:

- ★ LFCR box (see sec. 3.4),
- ★ uToF (see sec. 3.2),
- ★ for gas tube feedthroughs see sec. 4, fig. 38.



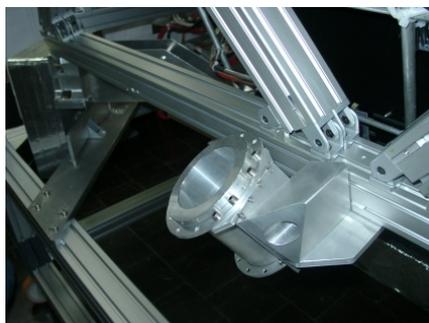
### Wall 3 - Wake

**Figure 14:** Dimensions of cable supports for cable feedthroughs wall 3 (WAKE)



### Wall 7 - Ram

**Figure 15:** Dimensions of cable supports for cable feedthroughs wall 7 (RAM)

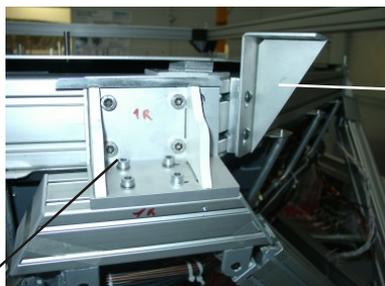


Star tracker baffle  
wall 1 & 5



Corner bracket with USS

Figure 16: Star tracker baffle & corner bracket

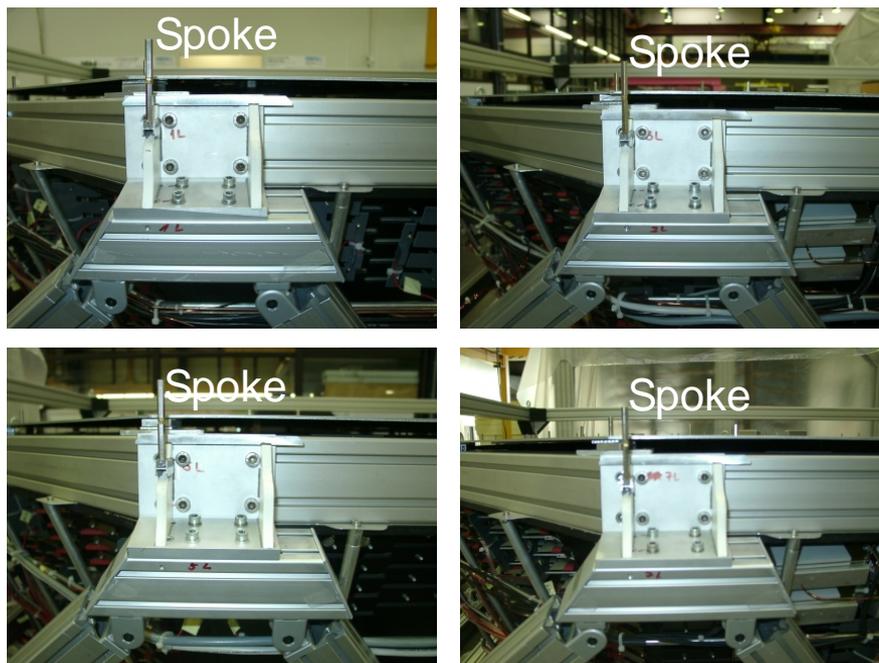


Bracket for Zenith  
Radiator

Upper bracket



Figure 17: Upper brackets and brackets for zenith radiator



Upper brackets with spokes for zenith radiator

**Figure 18:** Upper brackets with spokes for zenith radiator



**Figure 19:** Upper cover with spokes for zenith radiator

### 3 Cabling

#### 3.1 Cabling on rosegitter

This section has some additional information on the cabling at the rosegitter to the overview fig. 3 - 10. TRD HV and signal cables are running mostly on rosegitter bar A and B to avoid interferences with the temperature cables on bar C (fig. 20 and 21). Fig. 22 and 23 show the cabling starting from the bridges which are connected to the Dallas sensors to the temperature patch panels. Thicker temperature cables are running from the patch panels to the UG-crate.

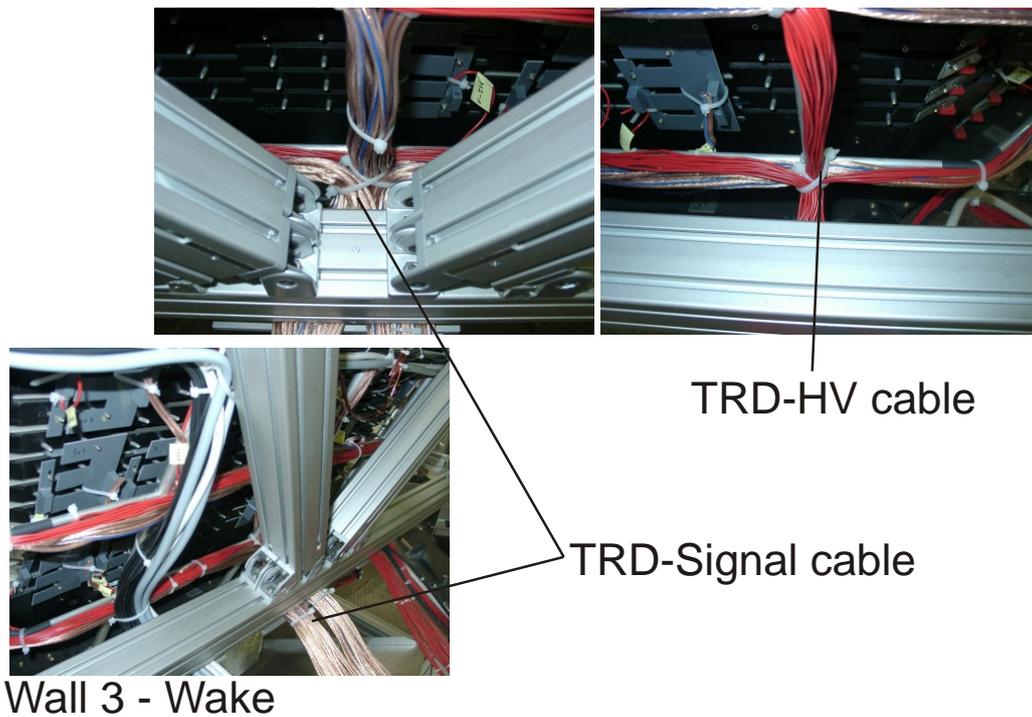
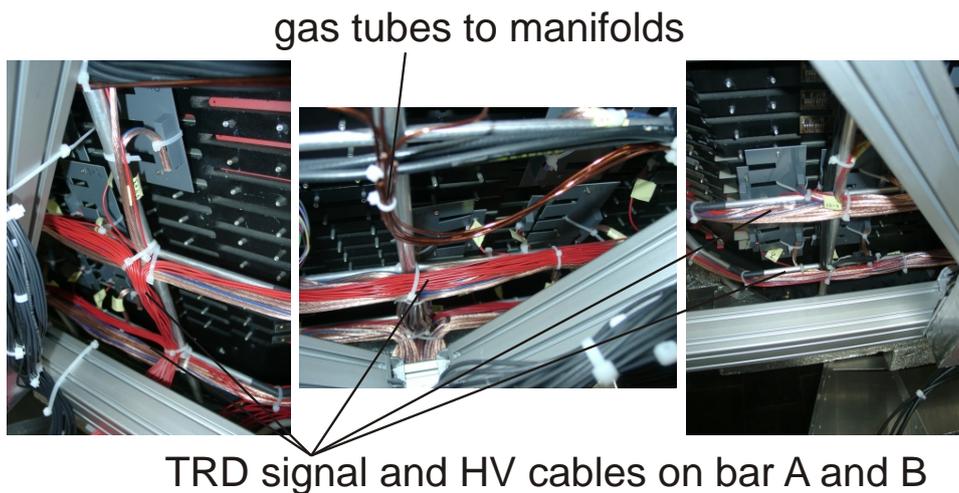
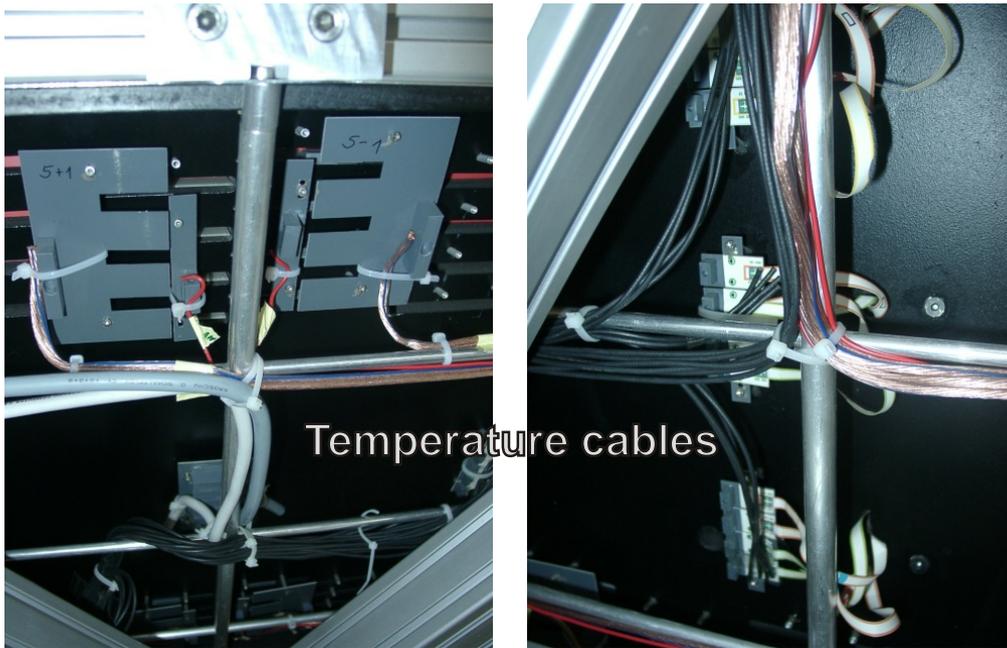


Figure 20: Cabling on rosegitter at wall 3 (WAKE)



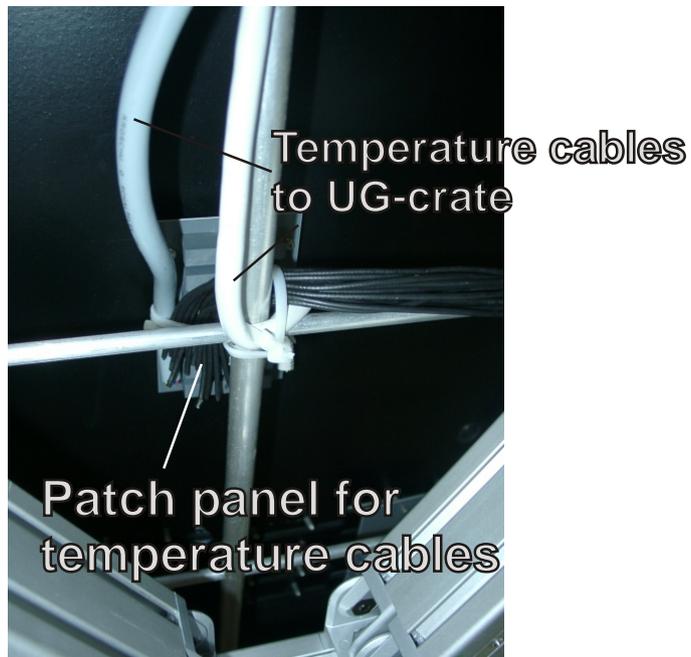
Wall 7 - Ram

Figure 21: Cabling on rosegitter at wall 7 (RAM)



Wall 5 - Starboard

Figure 22: Temperature cables at bridges



Wall 1 - Port

Figure 23: Patch panel for temperature cables

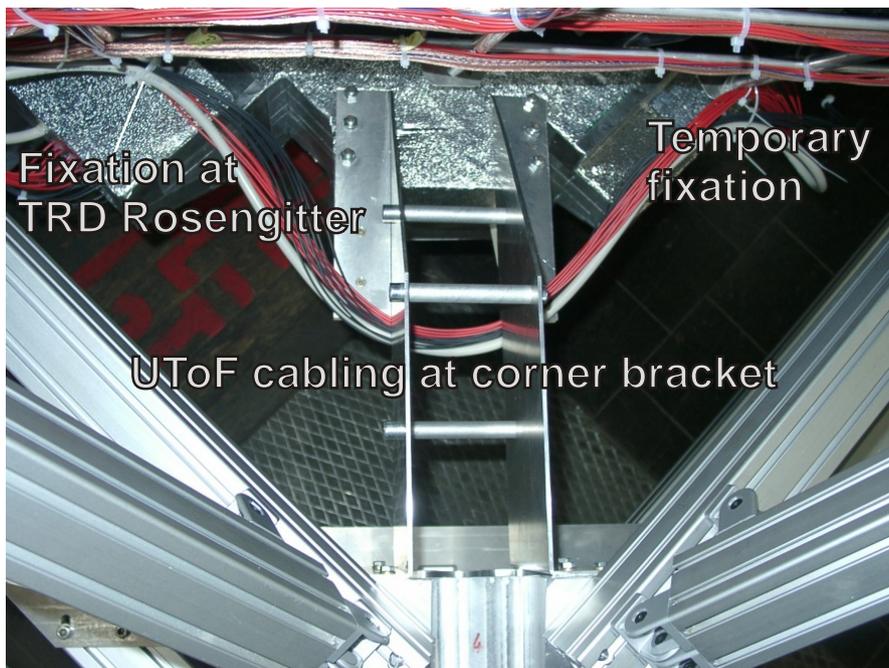
### 3.2 UToF & ACC cabling

This section shows pictures of the uToF mock-up mounted under the TRD and its cabling. For more detailed information on the lengths and type of the different cables contact Diego Casadei (INFN Bologna). There is a temporary fixation of the cables at the rosenegger, but the flight fixation will be on the uToF itself (fig. 24 and 25).

Upper Time of Flight



Figure 24: Overview uToF system



Wall 4

Figure 25: uToF cabling at wall 4

SHV box



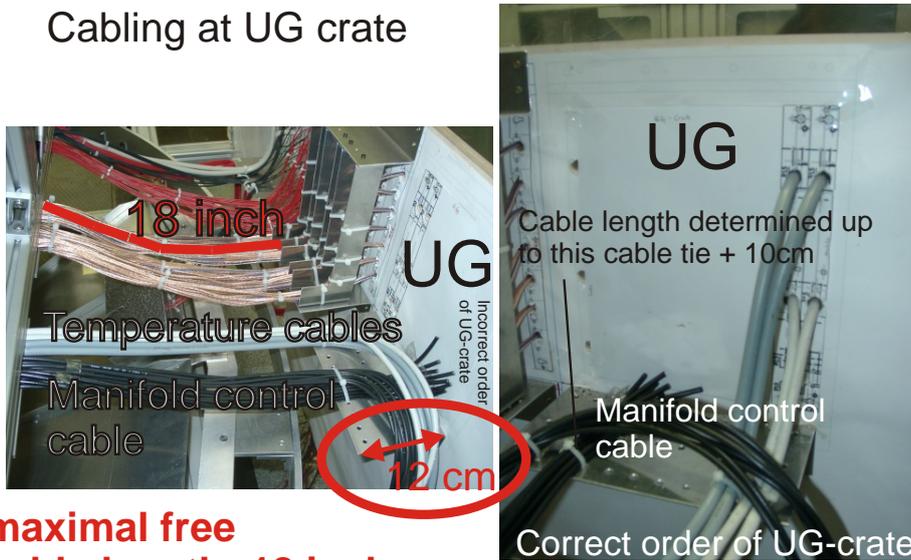
Wall 3 - Wake

Figure 26: SHV box at wall 3 (WAKE)

3.3 Cable supports

Cable supports are needed on the M-structure and at the crates. It is important For the design to match NASA restrictions of a maximal free cable lengths of 18 inches. This constraint defines the width of the support at the crate of about 12 cm (fig. 27 and 29). Fig. 28 shows pictures of the cabling at the crates (fig. 28 and 30). The fig. 30 and 31 show the cabling at the M-structure. For the different types of cables different types of supports are needed.

Cabling at UG crate

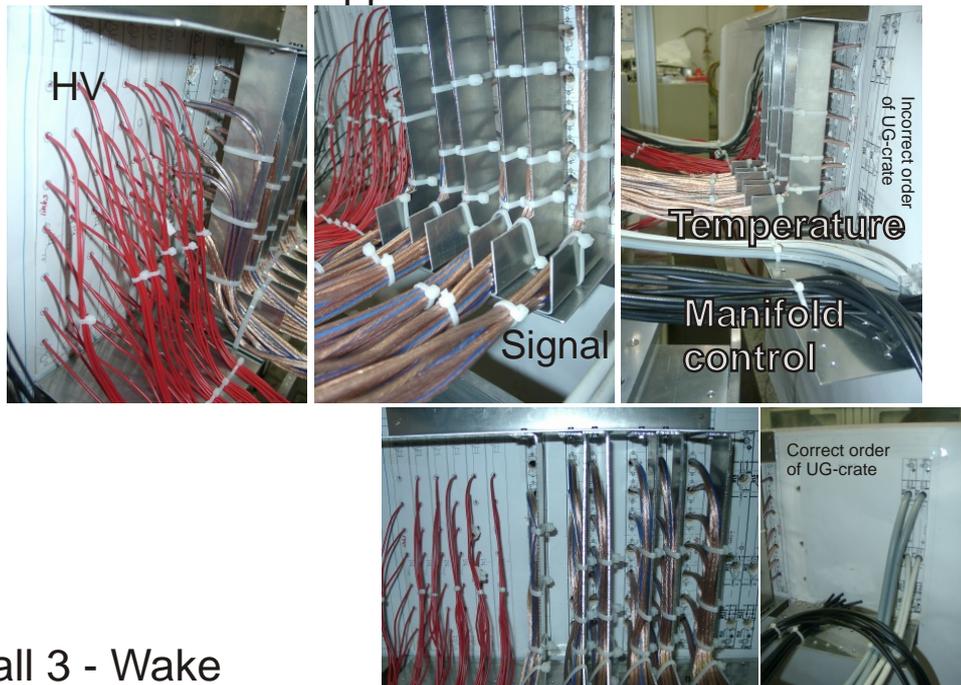


**maximal free cable length: 18 inch (NASA restrictions)**

Wall 3 - Wake

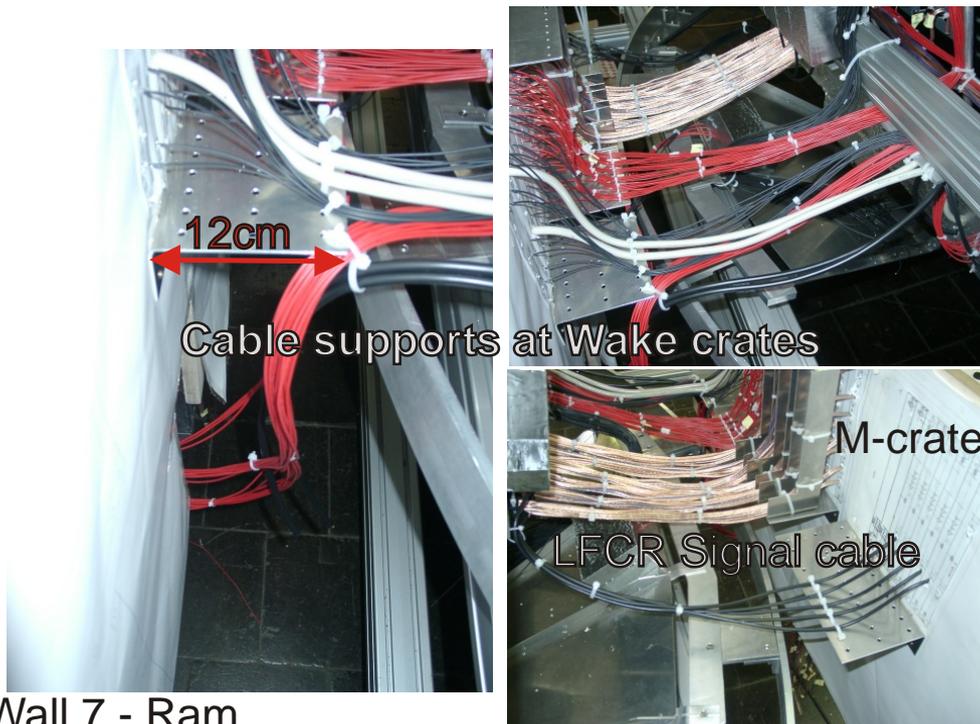
Figure 27: Cabling on UG-crate at wall 3 (WAKE)

### Cable supports at Wake crates



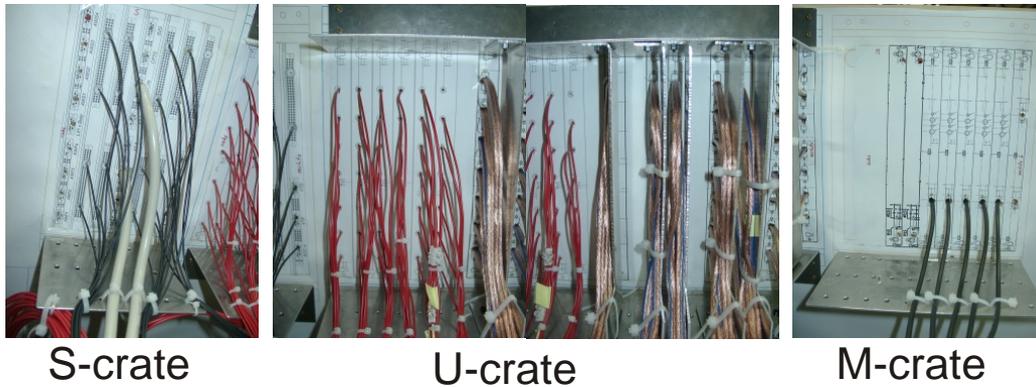
Wall 3 - Wake

Figure 28: Cable supports crates at wall 3 (WAKE)



Wall 7 - Ram

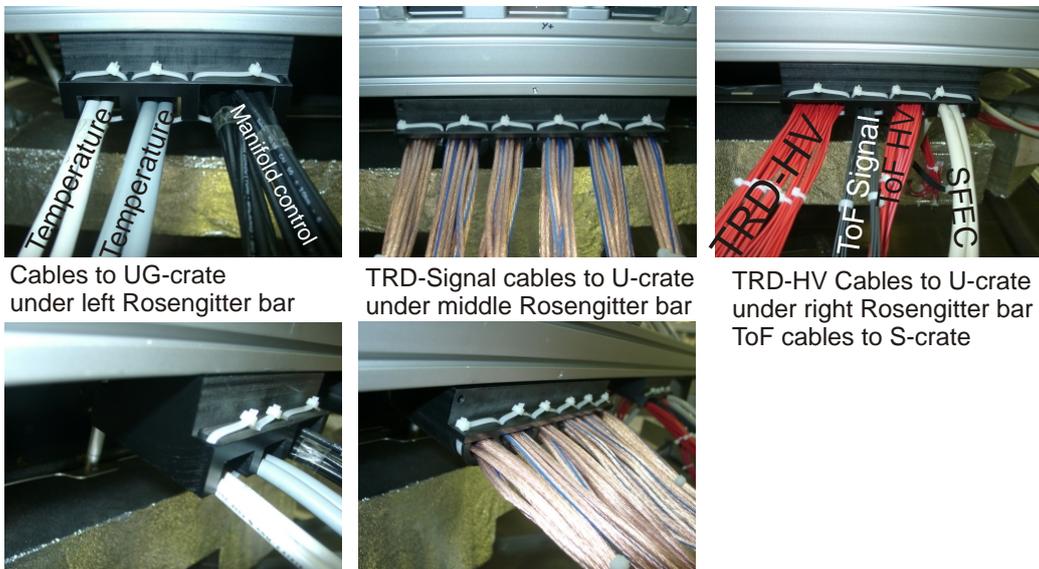
Figure 29: Cable supports crates at wall 7 (RAM)



### Wall 7 - Ram

Figure 30: Cabling crates at wall 7 (RAM)

### Cable supports at M-Structure



### Wall 3 - Wake

Figure 31: Cable supports M-structure at wall 3 (WAKE)



Cable supports at M-Structure

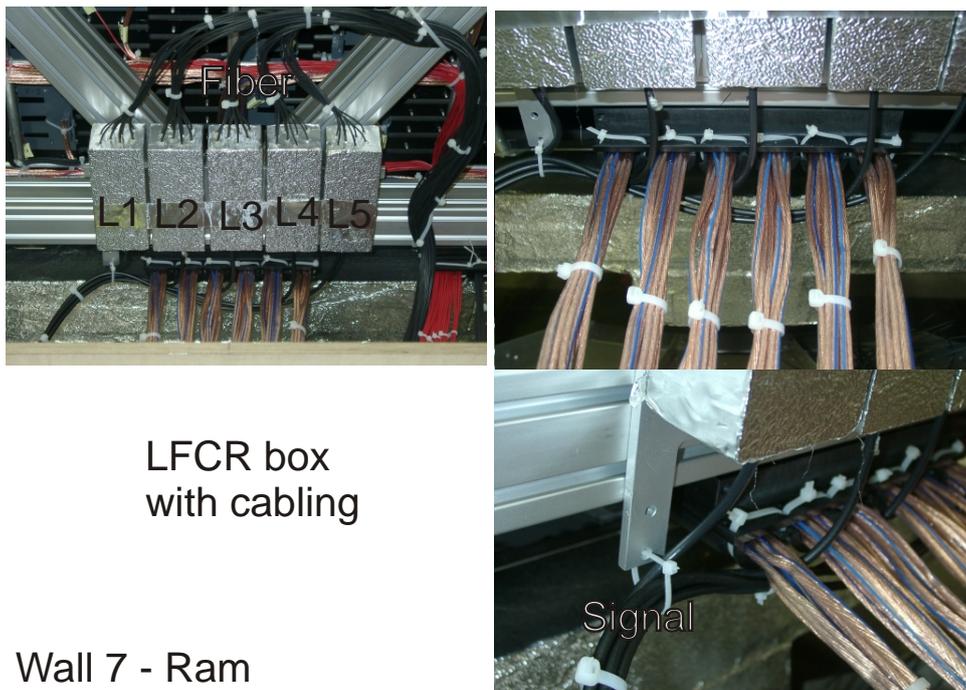


Wall 7 - Ram

Figure 32: Cable supports M-structure at wall 7 (RAM)

### 3.4 LFCR box with cabling

LFCR box is needed for the laser alignment system. On the ground plate of the LFCR box are some holes forseen for the grounding of the cables, fixation of the LFCR signal cables and the fixation of the MLI (fig. 33 and 34). Two fixations of the fibers at the M-structure will also be needed.



Wall 7 - Ram

Figure 33: LFCR box cabling at wall 7 (RAM)

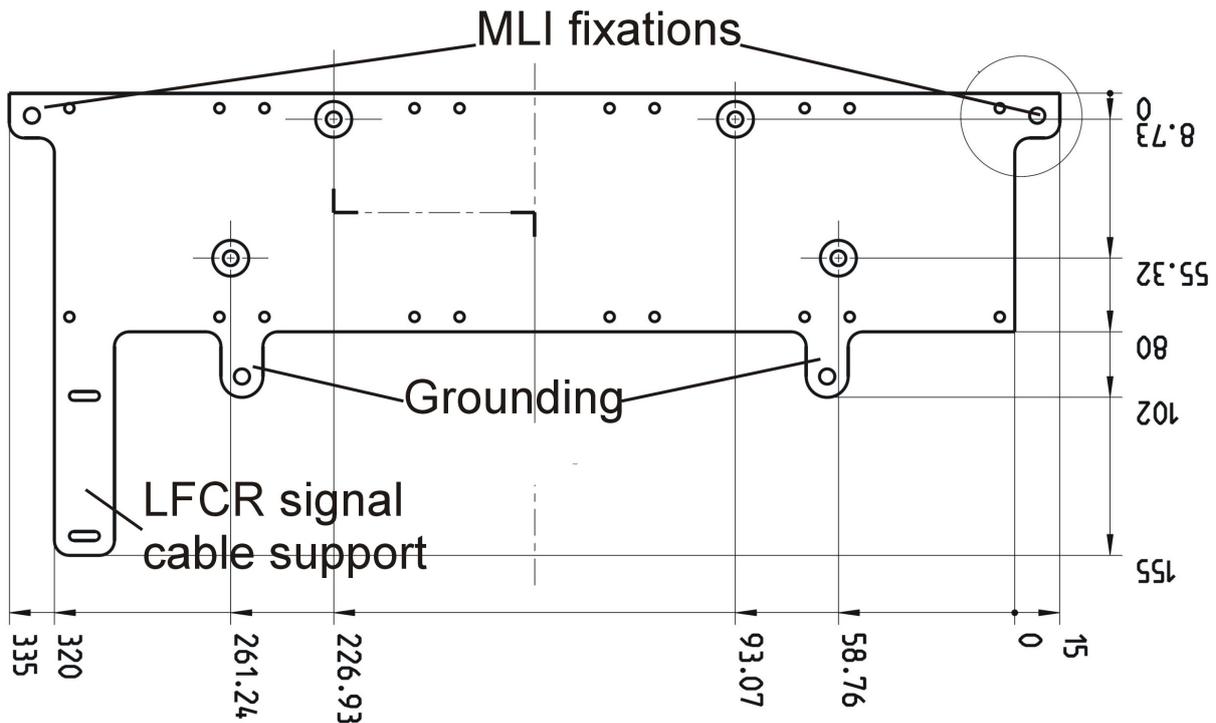


Figure 34: ISATEC drawing of LFCR box ground plate

### 3.5 Labeling scheme for the cables

This section introduces the labeling of the different cable types:

**Manifold control cables:** The cables have the labels R1 - R8 for the cables on the RAM side and W1 - W8 on the WAKE side. The manifolds are labeled according to fig. 9 and 39.

**Cables from temperature bridges to patch panels:** 4 cables from each Dallas sensor bridges are running to the patch panels. The labeling scheme is:

$$\langle \# \text{ wall of bridge} \rangle - \langle \text{label of Dallas sensors} \rangle$$

**Temperature cables from patch panel to UG-crate:** 2 cables are running from each panel (wall 1 and 5) to UG-crate. Cables on wall 1 are labeled T1.1/2 and on wall 5 T5.1/2.

**LFCR cables:** The signal cables of the LFCR boxes are labeled from left to right looking into the center according to fig. 33.

**TRD HV and signal cables:** TRD cables are labeled according to:

$$\text{HV: } H\langle \text{layer} \rangle \pm \langle \text{Number} \rangle$$

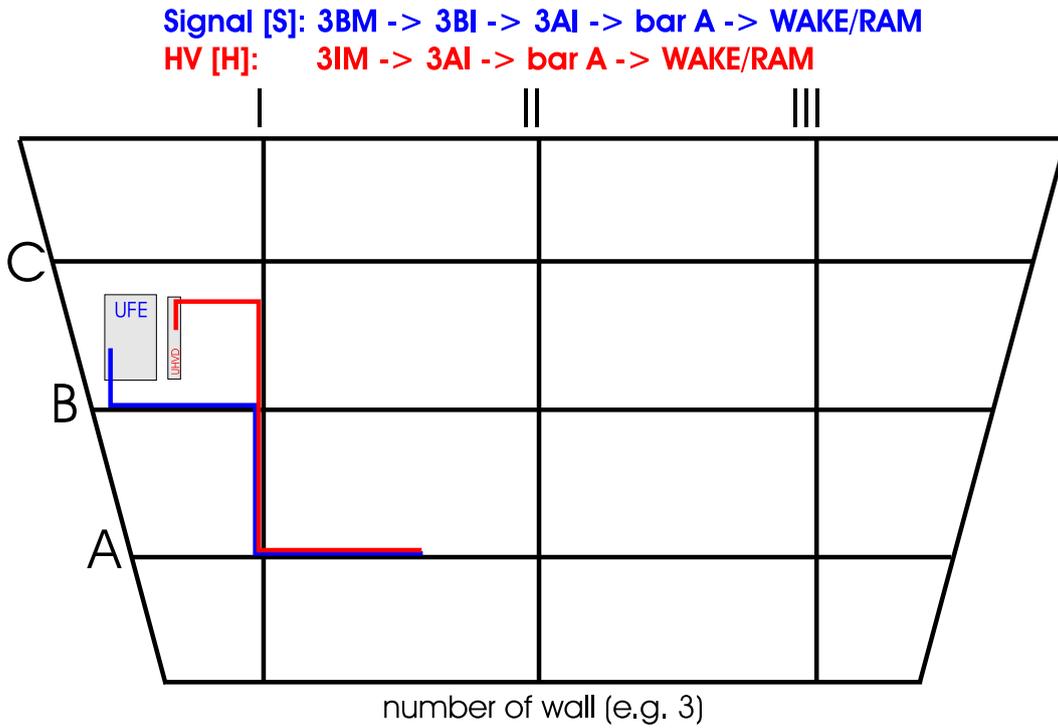
$$\text{Signal: } S\langle \text{layer} \rangle \pm \langle \text{Number} \rangle$$

For the numbering see fig. 35.



### 3.6 Routing

The documentation of the cable routing is based on the coordinate system of the rosengetter (fig. 36). TRD signal and HV cables are running mostly on bar A and B (tab. 1 - 5) and temperature and manifold control cables on bar C (tab. 6 - 9). Signal cables run to the middle rosengetter bar [AII] of RAM/WAKE crates. HV and uToF cables run to the right [AIII] (looking from outside to center). Temperature and manifold control cables run to the left [AI] (fig. 31 and 32). Temperature patch panel 1 is mounted on wall 1 and panel 5 is mounted on wall 5.



view from outside to center

**Figure 36:** Coordinate system of the rosengetter

Position	Type	Route	Crate side
1-7	H	8AM →bar A →	RAM
	S	"	"
1-6	H	8AM →bar A →	RAM
	S	8AM →bar A →	RAM
1-5	H	6AM →bar A →	RAM
	S	"	"
1-4	H	6AM →bar A →	RAM
	S	6AI →bar A →	RAM
1-3	H	1AM →bar A →	RAM
	S	1AI →bar A →	RAM
1-2	H	1AM →bar A →	RAM
	S	"	"
1-1	H	5AM →bar A →	RAM
	S	"	"
1+1	H	5AM →bar A →	WAKE
	S	"	"
1+2	H	1AM →bar A →	WAKE
	S	"	"
1+3	H	1AM →bar A →	WAKE
	S	1AIII →bar A →	WAKE
1+4	H	4AIII →bar A →	WAKE
	S	4AM →bar A →	WAKE
1+5	H	4AM →bar A →	WAKE
	S	"	"
1+6	H	2AM →bar A →	WAKE
	S	2AII →bar A →	WAKE
1+7	H	2AM →bar A →	WAKE
	S	"	"

**Table 1:** Routing for TRD signal and HV cables in layer 1

Position	Type	Route	Crate side	Position	Type	Route	Crate side
2-8	H	6AM →bar A →	RAM	3-8	H	6BM →6BII →6AII →bar A →	RAM
	S	"	"		S	"	"
2-7	H	6AM →bar A →	RAM	3-7	H	6BII →6AII →bar A →	RAM
	S	"	"		S	"	"
2-6	H	4AM →bar A →	WAKE	3-6	H	4BI →4AI →bar A →	WAKE
	S	"	"		S	4BII →4BI →4AI →bar A →	WAKE
2-5	H	4AI →bar A →	WAKE	3-5	H	4IM →4AI →bar A →	WAKE
	S	4AM →bar A →	WAKE		S	4BI →4AI →bar A →	WAKE
2-4	H	7AM →bar A →	RAM	3-4	H	7BM →bar B →	RAM
	S	7AI →bar A →	RAM		S	7BI →bar B →	RAM
2-3	H	7AI →bar A →	RAM	3-3	H	7BI →bar B →	RAM
	S	7AM →bar A →	RAM		S	7BM →bar B →	RAM
2-2	H	3AM →bar A →	WAKE	3-2	H	3BM →bar B →	WAKE
	S	"	"		S	"	"
2-1	H	3AM →bar A →	WAKE	3-1	H	3BM →bar B →	WAKE
	S	3AII →bar A →	WAKE		S	3BII →bar B →	WAKE
2+1	H	7AM →bar A →	RAM	3+1	H	7BM →bar B →	RAM
	S	7AII →bar A →	RAM		S	7BII →bar B →	RAM
2+2	H	7AM →bar A →	RAM	3+2	H	7BM →bar B →	RAM
	S	"	"		S	"	"
2+3	H	3AI →bar A →	WAKE	3+3	H	3BI →bar B →	WAKE
	S	3AM →bar A →	WAKE		S	"	"
2+4	H	3AM →bar A →	WAKE	3+4	H	3BM →bar B →	WAKE
	S	3AI →bar A →	WAKE		S	3BI →bar B →	WAKE
2+5	H	8AI →bar A →	RAM	3+5	H	8BM →8AI →bar A →	RAM
	S	8AM →bar A →	RAM		S	"	"
2+6	H	8AM →bar A →	RAM	3+6	H	8BM →8BI →8AI →bar A →	RAM
	S	"	"		S	"	"
2+7	H	2AII →bar A →	WAKE	3+7	H	2BII →2AII →bar A →	WAKE
	S	2AM →bar A →	WAKE		S	"	"
2+8	H	2AM →bar A →	WAKE	3+8	H	2BM →2BII →2AII →bar A →	WAKE
	S	"	"		S	"	"

**Table 2:** Routing for TRD signal and HV cables in layer 2

Position	Type	Route	Crate side
4-9	H	4BM →4BII →bar B →	WAKE
	S	4BII →bar B →	WAKE
4-8	H	4BM →4BII →bar B →	WAKE
	S	"	"
4-7	H	6CM →6CII →6BII →bar B →	RAM
	S	6BII →bar B →	RAM
4-6	H	6CM →6CIII →6BIII →bar B →	RAM
	S	"	"
4-5	H	4BM →bar B →	WAKE
	S	4IM →4BI →bar B →	WAKE
4-4	H	3CM →3CIII →3BIII →bar B →	WAKE
	S	3BIII →bar B →	WAKE
4-3	H	7IM →7BI →bar B →	RAM
	S	"	"
4-2	H	7BM →bar B →	RAM
	S	"	"
4-1	H	3IM →3BII →bar B →	WAKE
	S	3BM →3BII →bar B →	WAKE
4+1	H	3IM →3BII →bar B →	WAKE
	S	3BI →bar B →	WAKE
4+2	H	7CM →7CIII →7BIII →bar B →	RAM
	S	"	"
4+3	H	7BIII →bar B →	RAM
	S	7IM →7BII →bar B →	RAM
4+4	H	3BM →3BI →bar B →	WAKE
	S	3IM →3BI →bar B →	WAKE
4+5	H	2IM →2BIII →bar B →	WAKE
	S	"	"
4+6	H	8BI →bar B →	RAM
	S	8CM →8CI →8BI →bar B →	RAM
4+7	H	8BM →bar B →	RAM
	S	8IM →8BII →bar B →	RAM
4+8	H	2CI →2BI →bar B →	WAKE
	S	2CM →2CII →2BII →bar B →	WAKE
4+9	H	2IM →2BI →bar B →	RAM
	S	2BI →bar B →	RAM

**Table 3:** Routing for TRD signal and HV cables in layer 3

**Table 4:** Routing for TRD signal and HV cables in layer 4

Position	Type	Route	Crate side
5-9	H	6CM → 6CII → 6BIII → bar B →	RAM
	S	6CIII → 6BIII → bar B →	RAM
5-8	H	6CM → 6CII → 6BII → bar B →	RAM
	S	"	"
5-7	H	8CM → 8CII → 8BII → bar B →	RAM
	S	8CII → 8BII → bar B →	RAM
5-6	H	8CIII → 8BIII → bar B →	RAM
	S	8CM → 8CII → 8BIII → bar B →	RAM
5-5	H	6CM → 6CI → 6BI → bar B →	RAM
	S	6CI → 6BI → bar B →	RAM
5-4	H	5CM → 6CI → 6BI → bar B →	RAM
	S	"	"
5-3	H	1CI → 1BI → bar B →	RAM
	S	"	"
5-2	H	1CM → 1CI → 1BI → bar B →	RAM
	S	"	"
5-1	H	5CII → 5CIII → 5BIII → bar B →	RAM
	S	5CM → 5CII → 5BIII → bar B →	RAM
5+1	H	5CII → 5CIII → 5BIII → bar B →	RAM
	S	5CM → 5CII → 5CIII → 5BIII → bar B →	RAM
5+2	H	1CM → 1CIII → 1BIII → bar B →	WAKE
	S	"	"
5+3	H	1CIII → 1BIII → bar B →	WAKE
	S	"	"
5+4	H	5CM → 5CI → 5BI → bar B →	WAKE
	S	5CI → 5BI → bar B →	WAKE
5+5	H	4CM → 4CII → 4BIII → bar B →	WAKE
	S	4CIII → 4BIII → bar B →	WAKE
5+6	H	2CI → 2BI → bar B →	WAKE
	S	2CM → 2CI → 2BI → bar B →	WAKE
5+7	H	2CM → 2CII → 2BII → bar B →	WAKE
	S	2CII → 2BII → bar B →	WAKE
5+8	H	4CII → 4BII → bar B →	WAKE
	S	4CM → 4CII → 4BII → bar B →	WAKE
5+9	H	4CM → 4CI → 4BI → bar B →	WAKE
	S	4CI → 4BI → bar B →	WAKE

**Table 5: Routing for TRD signal and HV cables in layer 5**

W1	3CI → bar C →	WAKE
W2	"	"
W3	3CM → bar C →	WAKE
W4	"	"
W5	"	"
W6	"	"
W7	3CIII → bar C →	WAKE
W8	"	"
R1	6CI → bar C →	WAKE
R2	"	"
R3	6CM → bar C →	WAKE
R4	"	"
R5	"	"
R6	"	"
R7	6CIII → bar C →	WAKE
R8	"	"

**Table 6: Routing for manifold control cables**

Type	Route	Crate side
T1.1	1BII → 1CII → bar C →	WAKE
T1.2	"	"
T5.1	5BII → 5CII → bar C →	WAKE
T5.2	"	"

**Table 7: Routing for temperature cables from temp. patch panel to UG-crate**

Type	Route	Crate side
1.17H	1BM → 1BII →	Panel1
1.07H	"	"
1.17C	"	"
1.07C	"	"
1.15H	"	"
1.05H	"	"
1.15C	"	"
1.05C	"	"
1.13H	"	"
1.03H	"	"
1.13C	"	"
1.03C	"	"
3.19H	3CM → bar C → 1CIII → 1BIII → 1BII →	Panel1
3.09H	"	"
3.19C	"	"
3.09C	"	"
3.11H	3AM → 3AI → 3CI → bar C → 1CIII → 1BIII → 1BII →	Panel1
3.01H	"	"
3.11C	"	"
3.01C	"	"

**Table 8: Routing for cables from temp. patch panel to bridges (wall 1 & 3)**

Type	Route	Crate side
5.18H	5BM → 5BII →	Panel5
5.08H	"	"
5.18C	"	"
5.08C	"	"
5.16H	"	"
5.06H	"	"
5.16C	"	"
5.06C	"	"
5.14H	"	"
5.04H	"	"
5.14C	"	"
5.04C	"	"
7.20H	7CM → bar C → 5CIII → 5BIII → 5BII →	Panel5
7.10H	"	"
7.20C	"	"
7.10C	"	"
7.12H	7AM → 7AI → 7CI → bar C → 5CIII → 5BIII → 5BII →	Panel5
7.02H	"	"
7.12C	"	"
7.02C	"	"

**Table 9: Routing for cables from temp. patch panel to bridges (wall 5 & 7)**

### 3.7 U- & UG-crate assignment

The slot assignment of the U-crate is documented in tab. 10. The temperature cables at the UG-crate are assigned according to tab. 11.

RAM - Ucrate						
Slot-Nr. (UDR/UHVG):	9/16	7/15	6/14	4/13	3/12	1/11
top	3+6	3+5	2-3	2-4	1-1	
	4+6	1-2	2+1	3-3	1-4	5-1
	4+7	1-3	2+2	3-4	1-5	5+1
	5-2	1-6	3+1	4-2	2-7	5-4
	5-3	1-7	3+2	4-3	2-8	5-5
	5-6	2+5	4+2	4-6	3-7	5-8
bottom	5-7	2+6	4+3	4-7	3-8	5-9

WAKE - Ucrate						
Slot-Nr. (UDR/UHVG):	9/16	7/15	6/14	4/13	3/12	1/11
top		1+1	2-2	2-1	3+7	3+8
	4-8	1+4	3-1	2+3	1+2	4+8
	4-9	1+5	3-2	2+4	1+3	4+9
	5+4	2-5	4-1	3+3	1+6	5+2
	5+5	2-6	4+1	3+4	1+7	5+3
	5+8	3-5	4-4	4+4	2+7	5+6
bottom	5+9	3-6	4-5	4+5	2+8	5+7

Table 10: Assignment of slots in U-crates. Looking out from center

WAKE - UG-crate	
T1.2	T5.2
T1.1	T5.1
CAN	CAN

Table 11: Assignment of slots in UG-crate for UGSCMs. Looking out from center

### 3.8 Lengths

The lengths for the different types according to the labeling scheme (sec. 3.5) are documented in tab. 13 - 22. From the distributions of TRD HV and signal cables (fig. 37) one can propose lengths for spare cables (see tab. 12).

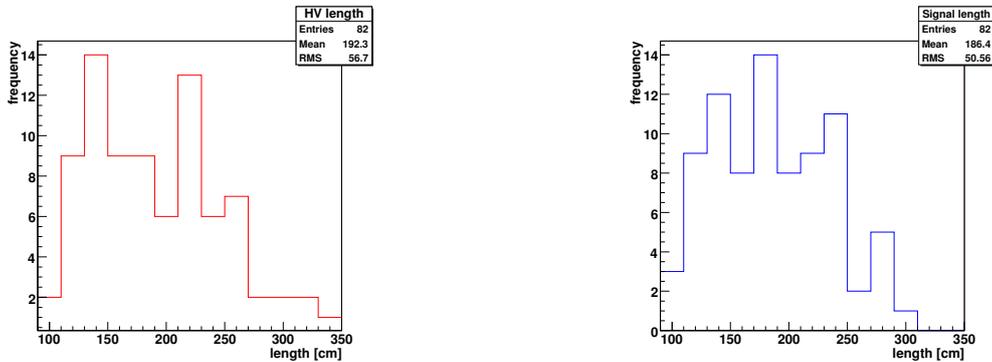


Figure 37: Distribution of TRD HV and signal cable lengths

HV:	150	270	340 cm
Signal:	150	250	310 cm

**Table 12:** Lengths for TRD HV and signal spare cables

Position	Type	Length [cm]	Position	Type	Length [cm]
1-7	S	148	2-8	S	189
	H	135		H	210
1-6	S	171	2-7	S	177
	H	153		H	200
1-5	S	188	2-6	S	163
	H	226		H	131
1-4	S	211	2-5	S	152
	H	249		H	120
1-3	S	226	2-4	S	125
	H	203		H	158
1-2	S	245	2-3	S	118
	H	219		H	153
1-1	S	249	2-2	S	118
	H	288		H	113
1+1	S	246	2-1	S	105
	H	222		H	123
1+2	S	244	2+1	S	98
	H	257		H	113
1+3	S	225	2+2	S	110
	H	269		H	107
1+4	S	205	2+3	S	117
	H	185		H	149
1+5	S	187	2+4	S	124
	H	169		H	163
1+6	S	172	2+5	S	146
	H	217		H	114
1+7	S	155	2+6	S	155
	H	194		H	127
			2+7	S	173
				H	193
			2+8	S	188
				H	209
			3-8	S	195
				H	221
			3-7	S	188
				H	212
			3-6	S	172
				H	135
			3-5	S	151
				H	123
			3-4	S	143
				H	177
			3-3	S	128
				H	179
			3-2	S	134
				H	134
			3-1	S	120
				H	131
			3+1	S	104
				H	136
			3+2	S	137
				H	127
			3+3	S	142
				H	165
			3+4	S	137
				H	174
			3+5	S	163
				H	140
			3+6	S	195
				H	157
			3+7	S	200
				H	226
			3+8	S	211
				H	233

**Table 13:** Lengths for TRD signal and HV cables in layer 1

**Table 14:** Lengths for TRD signal and HV cables in layer 2

**Table 15:** Lengths for TRD signal and HV cables in layer 3

Position	Type	Length [cm]
4-9	S	231
	H	212
4-8	S	228
	H	184
4-7	S	198
	H	244
4-6	S	190
	H	213
4-5	S	171
	H	125
4-4	S	157
	H	135
4-3	S	144
	H	175
4-2	S	127
	H	149
4-1	S	136
	H	146
4+1	S	134
	H	140
4+2	S	175
	H	136
4+3	S	136
	H	105
4+4	S	139
	H	175
4+5	S	167
	H	206
4+6	S	196
	H	144
4+7	S	205
	H	165
4+8	S	234
	H	257
4+9	S	233
	H	268

**Table 16:** Lengths for TRD signal and HV cables in layer 4

Position	Type	Length [cm]
5-9	S	181
	H	218
5-8	S	220
	H	243
5-7	S	211
	H	188
5-6	S	241
	H	211
5-5	S	240
	H	288
5-4	S	268
	H	291
5-3	S	265
	H	242
5-2	S	284
	H	254
5-1	S	289
	H	333
5+1	S	306
	H	329
5+2	S	282
	H	316
5+3	S	272
	H	294
5+4	S	273
	H	255
5+5	S	235
	H	222
5+6	S	248
	H	268
5+7	S	214
	H	247
5+8	S	221
	H	183
5+9	S	180
	H	165

**Table 17:** Lengths for TRD signal and HV cables in layer 5

Type	Length [cm]
W1	128
W2	121
W3	127
W4	124
W5	159
W6	152
W7	176
W8	166
R1	496
R2	480
R3	476
R4	473
R5	445
R6	425
R7	429
R8	428

**Table 18:** Lengths for manifold control cables. Determined up to cable tie in front of the UG-crate + 10 cm (see fig. 27)

Type	Length [cm]
1.17H	53
1.07H	53
1.17C	53
1.07C	53
1.15H	48
1.05H	48
1.15C	48
1.05C	48
1.13H	56
1.03H	56
1.13C	56
1.03C	56
3.19H	183
3.09H	183
3.19C	183
3.09C	183
3.11H	231
3.01H	231
3.11C	231
3.01C	231

**Table 21:** Lengths for cables from temp. patch panel to bridges (wall 1 & 3)

Type	Length [cm]
T1.1	290
T1.2	295
T5.1	350
T5.2	355

**Table 19:** Lengths for temperature cables from temp. patch panel to UG-crate

Type	Length [cm]
L1	75
L2	80
L3	85
L4	90
L5	95

**Table 20:** Lengths for LFCR signal cables

Type	Length [cm]
5.18H	53
5.08H	53
5.18C	53
5.08C	53
5.16H	48
5.06H	48
5.16C	48
5.06C	48
5.14H	56
5.04H	56
5.14C	56
5.04C	56
7.20H	183
7.10H	183
7.20C	183
7.10C	183
7.12H	231
7.02H	231
7.12C	231
7.02C	231

**Table 22:** Lengths for cables from temp. patch panel to bridges (wall 5 & 7)

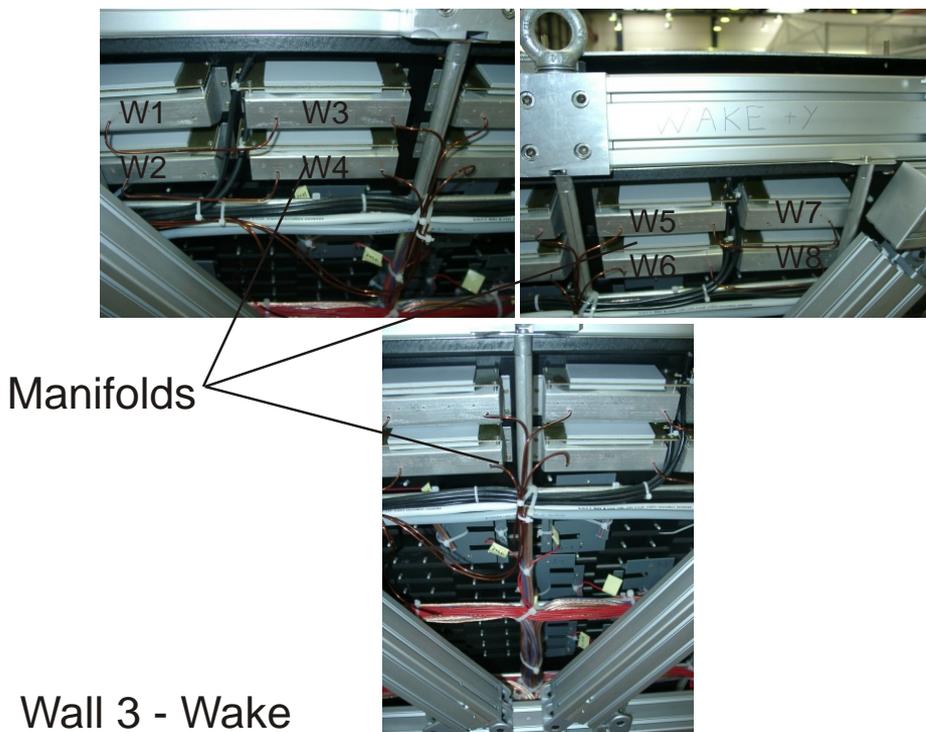
## 4 Gas tubing of manifolds

The gas tubing for the manifolds run on rosegitter bar C and jump to the M-structure to be connected to the patch panel at the corner bracket (fig. 38). From fig. 39 and 40 one sees some possible interferences between the manifolds and the rosegitter and the UFE and gas chain of one tower.



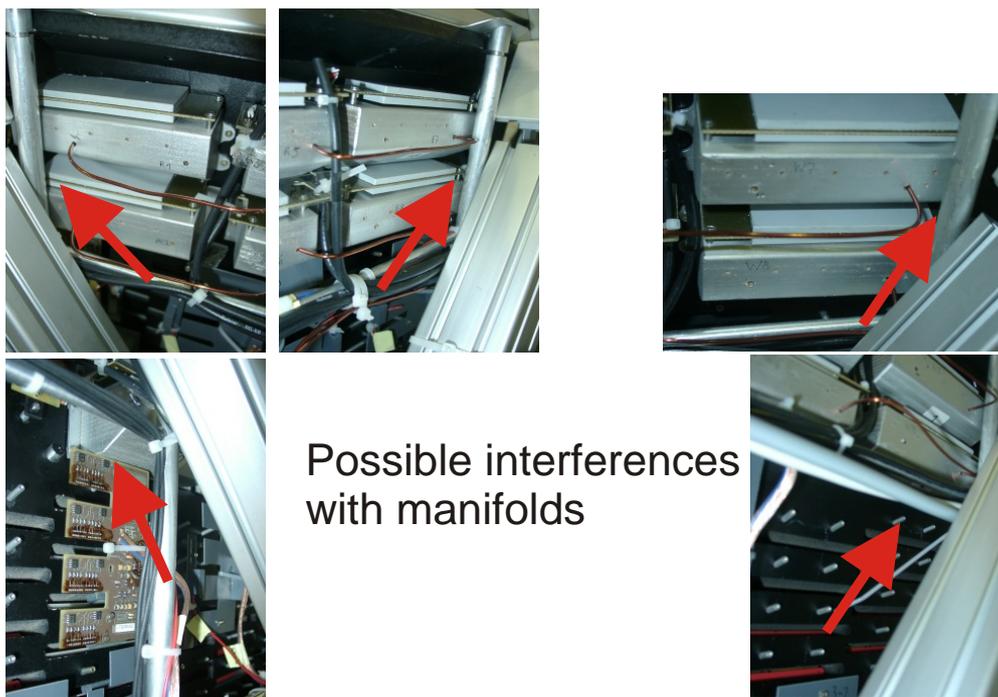
Wall 2/3

Figure 38: Gas tubing at the octagon



Wall 3 - Wake

Figure 39: Manifolds at wall 3 (WAKE)



**Figure 40:** Interferences: manifolds with UFE/gas chain